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(71) Applicant *(for all designated States except US)*: **FIT SMART BUILDING COMPONENETS LIMITED** [GB/GB]; 128 Broomloan Road, Glasgow G51 2BS (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **BUNTAIN, Christopher, Charles, MacIntosh** [GB/GB]; 8 Park Avenue, Greenock, Renfrewshire PA16 7QX (GB).

(74) Agent: **MURGITROYD & COMPANY**; Scotland House, 165-169 Scotland Street, Glasgow G5 8PL (GB).

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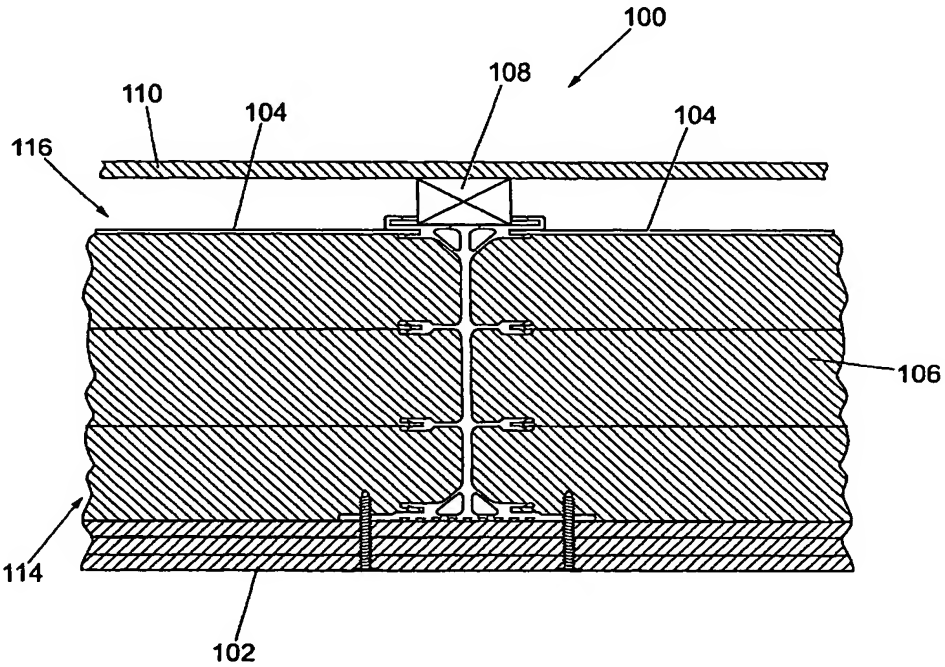
(54) Title: RIB FOR A WALL CONSTRUCTION



(57) Abstract: A structural rib (1) for a wall construction assembly, comprising a stiffening web (2) and first (4) and second (6) flanges at each end of the web, the first and second flanges being attachable to respective wall panels, the structural rib further comprising a supporting fin (48) extending from the web portion in a substantially lateral direction thereto.

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RIB FOR A WALL CONSTRUCTION

The present invention relates to a structural component or rib and to an insulated wall assembly formed using the structural rib.

There are requirements under building regulations in the United Kingdom and elsewhere to provide a certain standard of insulation for all building structures. In wall construction this is presently achieved by inserting various insulating materials into cavities in the wall structure and various methods of insulating these cavities have developed over the years. More recently, in order to increase the volume of the cavity available for insulation, framed construction of timber or steel has been employed. Framed construction is structural and has the advantage of lending itself to prefabrication.

In all cases, the amount of insulation insertable into the cavity is limited by the size of the cavity, e.g. the distance between the internal leaf and external leaf forming a masonry cavity wall. However, in this case the size of the cavity is limited by structural considerations. To place the internal leaf and external leaf too far apart would create a structurally unsound wall which may collapse over time. To offset this and to maximise the size of cavity available for insulation, wall ties are employed to create anchoring points connecting the inner leaf and outer leaf together, thus lending structural stability to the wall. Demands for greater insulation will necessitate the use of longer wall ties but their length will be constrained by the ability of the wall to act as a structural composite and remain stable. In short, a balance must be struck between the size of the cavity and the minimum insulation which is necessary to insulate the building structure. However, the thickness of insulation required to meet the regulations in the future may result in the demise of the masonry cavity wall as a form of load bearing construction.

Framed construction is an attractive alternative as it offers speed of erection, prefabrication off site, and is less dependant on traditional skills and materials. While offering extensive cavities for insulating it is not complete in itself and requires the application of weatherproof cladding and an internal lining.

As building standards and environmental regulations become more stringent, greater amounts of insulation and better insulation methods will be required. Consideration has also to be given to the positioning of the insulation in the wall construction to avoid the risk of harmful condensation forming.

More recent methods of insulating cavity walls provide for a partial fill of the cavity with insulation, such that a portion of the cavity still remains between the outer face of the insulation and the inner face of the external leaf of the cavity wall. This is done in order to prevent cold bridging between the outer leaf and inner leaf of the cavity wall and to prevent the ingress of moisture thereacross. This, however, reduces even further the amount of insulation in the cavity.

To date, insulating the external face of the outer leaf of the cavity wall has not been an option. To employ the methods and materials used to date would not be suitable for this purpose.

The application of insulation to the outer surface of a cavity masonry wall would have the benefits of providing better insulation standards, good weather defences and a sound structure. Presently, such application would be dependent on traditional constructional skills and materials and would not lend itself to fast methods of construction.

In general, it is anticipated that conventional cavity masonry will be unable to cope with the large volumes of insulation demanded by future building standards. Any solutions to the problems associated with the prior art must minimise the complexity of sophisticated external wall composites and the range of products found in wall sandwiches. Construction systems are required which meet industry standards and yet facilitate quick and easy erection without excessive skill requirements. Moreover, construction methods must be highly adaptable to facilitate architectural design requirements.

In short, construction system and methods are increasingly required which facilitate a high level of insulation to reduce fuel consumption, prevent fuel poverty, facilitate heating and which meet stringent building regulations. Insulation employed is generally of three main types, namely, mineral fibre slabs, granular filling or plastics foam slabs. The insulation material is generally placed internally or within a cavity both of which have the limitations and disadvantages outlined above.

It is an objection of the invention to overcome the problems of the prior art.

According to the invention there is provided a structural rib for a wall construction assembly, comprising a web and first and second flange portions, the first and second flange portions being attachable to respective wall panels, the structural

component further comprising a first fin extending from the web portion in a substantially lateral direction thereto.

Preferably, the structural component has a second fin extending from the web portion in a direction opposite to that of the first fin.

Preferably, the first and second fins are co-planar and extend from the web portion to form an angle of 90^0 with the web portion.

Optionally, the structural component has a plurality of first and second fins extending from the web portion, such that each pair of first and second fins are co-planar and extend from opposite sides of the web portion.

Preferably, the first and second fins have a free end.

Preferably, the free end of the first and/or second fins is adapted for complementary engagement with cladding accessories, for example, insulation restraining straps, bars or panels.

Preferably, the free end of the first and/or second fins has a slot for receiving the cladding accessories.

Preferably, the slot is adapted to resist withdrawal of the cladding accessory after its insertion therein.

Preferably, the first and second flange portions of the structural component have slots in opposite sides thereof for receiving cladding accessories for example, insulation restraining straps, bars or panels.

Preferably, an end wall of the first and/or second flange portions of the structural component are grooved to receive adhesive to secure the first and/or second flange portions to the respective wall panels. Conventional securing means can also be used, for example, a nut and bolt, screw or rivet.

Typically, the structural component is made of a strong, lightweight material, for example, aluminium, steel, alloy or glass reinforced composite. Preferably the structural component is an extrusion.

According to a further aspect of the present invention there is provided a wall construction assembly, comprising a plurality of spaced structural components, each structural component comprising a web, first and second flange portions, and one or more pairs of opposed first and second fins extending from the web portion in a substantially lateral direction thereto, the assembly further comprising at least one wall panel connected to one of the first and second flange

portions and insulation held between adjacent structural components.

Preferably, the assembly has a second wall panel connected to the other of the first and second flange portions.

Preferably, the assembly has insulation disposed between the first and second fins of the structural component, and the first and/or second wall panel, the insulation extending between adjacent structural components.

Preferably, the first and second flange portions of the structural component have slots in opposite sides thereof for receiving cladding accessories for example, insulation restraining straps, bars or panels.

Preferably, the free end of the first and/or second fins is adapted for complementary engagement with cladding accessories, for example, insulation restraining straps, bars or panels. In this way, the restraining means can divide the insulating body into compartments which can be filled with different types of insulating material or can be left empty as desired.

Preferably, the free end of the first and/or second fins has a slot for receiving the cladding accessory. The cladding accessory may be a rigid

strap spanning between adjacent structural components.

Preferably, the slot is adapted to resist withdrawal of the cladding accessory after its insertion therein.

Preferably, each structural component comprises a plurality of pairs of opposed first and second fins extending from the web portion in a substantially lateral direction thereto, arranged at a regular spacing along the web. Preferably, the spacing along the web between the pairs of fins is substantially equal to the spacing along the web between the first flange and the pair of fins adjacent to the first flange. Preferably, the spacing along the web between the pairs of fins is substantially equal to the spacing along the web between the second flange and the pair of fins adjacent to the second flange.

Preferably, an end wall of the first and/or second flange portions of are grooved to receive adhesive to secure the first and/or second flanged portions to the respective wall panels. Conventional securing means can also be used, for example, nut and bolt, screw or rivet.

Optionally the first and/or second wall panels can comprise two or more wall panels.

Preferably, there is provided a ventilation space between the first and/or second flange portions of the structural component and the first and/or second wall panels.
This ventilation space may be provided by a spacing member extending between the first and/or second flange portions and the first and/or second wall panels.

The ventilation space may also be provided or increased by removing the insulation between the first and second fins and the first and/or second flange portions.

The structural components, assemblies and methods of the invention enjoy a number of advantages over the prior art. More particularly, the invention facilitates high levels of insulation, minimises cold bridging, eliminates condensation risks, reduces air leakage significantly, minimises fire risks and results in low whole life costs. Moreover, the invention provides structural soundness, ease of construction, is cost efficient and has an acceptable appearance for architectural purposes. The invention further is easily adapted for use of large volumes of insulation, is a complete composite structural packages, employs tough, robust materials having a rigid feel, exhibits impressive acoustic performance, helps to protect against adverse weather using defensive cavities, is suitable for use with a wide range of architectural finishes, is suitable for use for all

building types and sizes, facilitates rapid, dry building construction, employs materials of low or no combustibility and can be designed to minimise air leakage.

An embodiment of the invention will now be described, by way of example only, having regard to the accompanying drawings in which:-

Fig. 1 is a cross sectional plan view of a structural rib in accordance with the invention;

Fig. 2 is cross-sectional plan view of an external wall construction assembly or composite in accordance with the invention in which the structural rib of Fig. 1 is disposed between a cladding panel and a wall panel;

Fig. 3 is a cross-sectional perspective view from above of the wall construction assembly of Fig. 2 showing the make-up of the wall panel;

Fig. 4 is an exploded view of the wall panel of Figs. 2 and Fig. 3 with the slip feather joints separated from the cement particle panels;

Fig. 5 is an enlarged cross-sectional view of the second flange of the structural rib of Fig. 2 attached to the wall panel with oppositely disposed mounting screws;

Fig. 6 is an enlarged cross-sectional view of the second flange of the structural rib attached

directly to a masonry wall with a fixing and to a structural steel member with a bolt, with an adhesive being disposed between the rib and the panel;

Fig. 7 shows the first flange of the structural rib attached to a cladding panel with a tie;

Fig. 8 is an enlarged view of Fig. 7 without the cladding panel and showing the insulation straps;

Fig. 9 shows the first flange of the structural rib attached to a masonry wall and the second flange of the structural rib attached to a wall panel with a wall-tie fixing;

Fig. 10 shows use of the structural rib in a conventional cavity wall made up of brick/block cavity wall with the second flange rib of the structural rib being attached to the wall panel with a wall fixing;

Fig. 11 shows a structural rib having three pairs of fins;

Fig. 12 shows a structural rib having a single pair of fins;

Fig. 13 is a second embodiment of a structural rib of the invention provided with a central screw mounting at the apex 8 on the central web portion 2;

Fig. 14 is a cross sectional view of the structural rib of Figure 13 mounted between a cladding panel and a wall panel;

Fig. 15 is a enlarged cross sectional view of a portion of the structural rib of Figure 13 being attached to the wall panel;

Fig. 16 is a cross-sectional view of the structural rib of Figure 13 attached to a masonry wall and to a steel framing with an adhesive disposed between the structural rib and the masonry component;

Fig. 17 is a cross-sectional view of the structural rib of Figure 13 mounted at the cladding panel, and

Fig. 18 is a side cross-sectional view of the structural rib of Figure 13 in use, and

Fig. 19 is a partial perspective view of the assembly of Figures 13 to 18.

Referring to the drawings and initially to Fig. 1, there is shown a structural rib generally indicated by the reference numeral 1, having a central elongate stiffening web 2 and first and second generally triangular shaped flanges 4,6 respectively either end of the central stiffening web 2. The structural component 1 defines a longitudinal axis L-L along the central web between the first flange 4 and the second flange portion 6. The structural rib 1 is symmetrical about the longitudinal axis L-L.

The structural rib 1 serves to form a bridge across a cavity in an external wall and acts as a supporting element in use.

The stiffening web 2 has two pairs of mounting fins 48, which extend laterally from the stiffening web in opposite directions perpendicular to the longitudinal axis L-L of the structural component 1. Each pair of fins 48 are contiguous through the stiffening web 2 and are spaced apart from each other along the stiffening web 2. Each fin 48 is in the shape of a rod having a two pronged-fork end portion 50. Each prong 52,54 of the forked end portions 50 have grooves 56,58 on its inner faces for receiving clip-in attachments.

The flanges 4 and 6 have apices 8 and 10, side walls 12,14 and 16,18 and bases 20 and 22 respectively. The web 2 extends through the apices 8 and 10 to meet the bases 20 and 22 of each triangular flange 4 and 6, respectively, such that the longitudinal axis L-L bisects each triangular flange 4 and 6.

The side walls 12,14 of the first flange 4 gradually curve to meet the base 20 at areas of contact A and B defined by a thickening of the side walls 12,14 generally midway along their length. Both side walls 12,14 and the base 20 continue to extend beyond their area of contact A and B parallel to each other, spaced apart and perpendicular to the longitudinal axis L-L to define slots 24,26

therebetween. The slots 24,26 have grooves 28,30 in the side walls 12,14 also for receiving clip-in attachments. The free ends of the base 20 are shaped back on themselves away from the web portion 2 so that they face each other forming U-shaped sections 32 and 34. A channel 112 is defined between the free ends of the base 20 for receiving a spacing block 108 as discussed further below.

The second flange 6 is similar in shape to the first flange 4. However, the free ends of the base 22 are not shaped back on each other to form U-shaped sections, but rather extend a distance beyond the free ends of the side walls 16,18 parallel thereto and perpendicular to the longitudinal axis L-L to define further slots 36,38 for receiving between the side walls 16, 18 and base 22. As previously described, the slots 36,38 have grooves 40,42 in the side walls 16,18 to facilitate the clip-in attachment.

The base 22 of the flange 6 also has recesses 44 along a portion of the length of its side remote from the web 2. In all other respects, the flange portions 4 and 6 are identical.

Referring now to Fig. 2, there is shown a section of a wall construction assembly of the invention generally indicated by the reference numeral 100, which shows the position and function of the structural rib 1 in the external wall construction made up of a wall panel 102 and a cladding panel 110

spaced apart from the wall panel 102 to define a cavity 114 for receiving insulation therebetween.

The second flange 6 is attached with screws to the wall panel 102 which is described in more detail below. Insulation restraining straps 104 are clipped into the slots 24,26 of the first flange portion 4. The straps 104 have formations thereon(not shown) which engage with the grooves 28,30 to resist withdrawal of the straps therefrom. Insulating material 106, indicated by the shading portion in Fig. 2, is placed within the space formed between the wall panel 102 and the straps 104. The spacing block 108 is mounted in the channel 112 and is also fixed to the cladding panel 110. The spacing block 108 provides for a ventilation space 116 between the insulating material 106 and the cladding panel 110.

Although Fig. 2 only shows a single structural rib 1 in the wall construction assembly 100, it will be appreciated that a number of these components, as required, can be placed along the length of the wall panels 102, 110.

The structural rib 1 is formed from a strong material, such as, for example, aluminium or steel. Owing to the shape of the structural rib 1, no further support is necessary to maintain the structural integrity of the wall construction assembly 100. The broad profile of the first and second flanges 4,6 add stiffness and strength to the

structural rib 1, the web 2 adding longitudinal stiffness and strength, and the fins 48 adding lateral stiffness, strength and overall structural integrity to the wall construction assembly 100.

In use, the wall construction assembly 100 is capable of providing insulation to any required standard, can be placed about the internal or external walls of a building structure as desired and can be attached to the walls in any conventional manner. However, due to the strength of the structural component 1, the wall construction assembly 100 is structurally very sound and does not need the support of the wall of the building structure and as such does not need to be attached thereto. In short, the wall construction asembly of the invention can serve as a standalone structure or can be used in combination with existing structures.

Fig. 3 shows the structural rib 1 located between the cladding panel 110 and the wall panel 102. As shown in the drawing, the structural rib 1 is adapted to secure insulation 106 between the cladding panel 110 and the wall panel 102.

The wall panel 102 for use in the wall construction assembly 100 of the invention is made up of a composite of individual horizontal panels 118 having channels 120 at the periphery thereof for receiving slip feather joint 122 therein to interconnect the panels 118. The panels 118 of the wall panel 102 are typically formed from cement particle panels

having a thickness of approximately 25 mm while the slip feather joints 122 are dimensions to be received within the channels 120. As shown in Figures 3 and 4, the panels 118 and the slip feather joints 122 are interconnected to assemble the wall panel 102.

As shown in Figure 5, the flange 6 of the rib 1 is attached to the wall panel 102 by a machine driven screw 124 inserted through the base 22 to initially produce a tight interface between the rib and the wall panel 1 to prevent jacking off. Subsequently, a primary screw 126 which is the primary structural fixing is inserted through the wall panel 102 into the base 22 to secure the rib to the wall panel 102.

As shown in Figure 6, the rib 1 can also be secured to a masonry wall 128 by a proprietary fixing such as a bolt-type fixing 130. Additional bond strength can be achieved by locating an adhesive such as an epoxy mastics 132 between the base 22 and the masonry wall 128. The adhesive 132 is received within the recesses 44.

Alternatively, where the rib 1 is to be secured to a steel framing starter angle or the like, a conventional bolt 132 can be employed.

It will be appreciated from the foregoing that the amount of insulation is not limited by the cavity 114 of the building structure. As insulation can now be added externally of the walls of the building

structure, the thickness of the insulation added is not limited. Different sized structural ribs 1 can be used for this purpose as shown in Figures 11 and 12. Where a thicker wall construction assembly 100 is employed it may be prudent to use a greater number of structural ribs 1 to ensure that the wall construction assembly 100 is structurally stable.

It will be also be appreciated that various different embodiments of the wall construction assembly 100 may result from the present invention and that the structural rib 1 can be used in a number of ways. For example, in an alternative embodiment of wall construction assembly 100, the cladding panel 110 may be connected directly to the first flange 4. Ventilation space may be provided by placing the insulation restraining members 104 between the forked end portions 50 of the fins 48.

It will further be appreciated that the first flange 4 may be attached to the panel 110 in a number of different ways, a typical example being shown in Fig. 7 where one end of a suitably shaped tie 120 engages the u-shaped sections 24,26 of the first end portion 4, the other end of the tie 120 being fixed to the panel 110.

It will be appreciated that the structural component 1 is also suitable for using in a conventional cavity wall 134. This is shown most clearly in Figure 10. Due to the structural stiffness and strength of the structural component 1, the distance

between the inner leaf 136 and outer leaf 138 of the cavity wall may be greater than conventional spacing, allowing an increased amount of insulation to be placed there between. The rib 1 can be secured to the outer leaf 138 by a conventional wall-tie head 140. As shown in Figure 9, the rib 1 can also be employed in a wall construction made up of an outer leaf 138 and an inner wall panel 102 as previously described.

Figures 13 to 19 show a second embodiment of a structural rib 1 and a corresponding structural wall assembly 100 in accordance with the invention.

As shown in the drawings, the structural rib 1 is broadly similar to the structural rib 1 described in figures 1 to 12 and, accordingly, like numerals indicate like parts. However, in the present embodiment, the flanges 4, 6 have a more rigid head profile. More particularly, the flanges 4, 6 are substantially U shaped in cross-section having a central bore 142 disposed about the longitudinal axis L-L for receiving a screw slot fixing 144 for securing the rib 1 to a cladding panel 110 or a wall panel 102. As shown in the drawings, the rib 1 is located between a cladding panel 110 and a wall panel 102 as previously described. However, in the present embodiment, a continuous primary fixing rail 146 is attached to the structural rib 1 at the flange 4 which is held in place by the fixing 144. The continuous primary fixing rail 146 supports an outer layer of dense insulation such as ROCKWOOL 148

between the structural rib 1 and the spacing block 108. Accordingly, in the present embodiment an additional layer of insulation is provided externally of the structural rib 1. The additional insulation layer typically has a minimum thickness of 30 mm and is supported on the rail 146 which also serves to provide mountings for the cladding panel 110 as shown in figures 18 and 19.

As previously described, the structural rib 1 therefore facilitates the assembly of wall panels in a wall structure assembly and also provides load bearing strength for insulation and panels alike.

As shown in Figure 15, the flange 6 is secured to the wall panel 102 as previously described employing a machine driven screw 124 and a structural screw 126.

As shown in Figure 17, the spacing block 108 is secured to the rail 146 by a screw such as a stainless self drill/self tapping screw 150.

Figures 18 and 19 clearly demonstrate the structure of the wall assembly 106 of the second embodiment. As shown in the drawings, the assembly is further provided with a thermo-break packer 152 between the structure rib 1 and the rail 146.

Claims

1. A structural rib for a wall construction assembly, comprising a stiffening web and first and second flanges at each end of the web, the first and second flanges being attachable to respective wall panels, the structural rib further comprising a supporting fin extending from the web portion in a substantially lateral direction thereto.

2. A structural rib as claimed in Claim 1 which has a second mounting fin extending from the web in a direction opposite to that of the first fin.

3. A structural rib as claimed in Claim 3 wherein the first and second fins are co-planar and extend from the web to form an angle of 90^0 with the web.

4. A structural rib as claimed in Claim 3 wherein the structural component has a plurality of first and second fins extending from the web, each pair of first and second fins being co-planar and extending from opposite sides of the portion.

5. A structural rib as claimed in any of Claims 2 to 4 wherein the free end of the first and/or second fins is adapted for complementary engagement with cladding accessories.

6. A structural rib as claimed in Claim 5 wherein the cladding accessories comprise insulation restraining straps, bars or panels.

7. A structural rib as claimed in Claim 5 or 6 wherein the free end of the first and/or second fins has a slot for receiving the cladding accessories.

8. A structural rib as claimed in Claim 7 wherein the slot is adapted to resist withdrawal of the cladding accessory after its insertion therein.

9. A structural rib as claimed in any of Claims 1 to 8 wherein the first and second flanges of the structural component have slots in opposite sides thereof for receiving cladding accessories.

10. A structural rib as claimed in any of Claims 1 to 9 wherein an end wall of the first and/or second flange portions of the structural component are grooved to receive adhesive to secure the first and/or second flange portions to the respective wall panels.

11. A structural rib as claimed in any of Claims 1 to 10 further comprising attachment means for attaching the structural rib to a wall or cladding panel.

12. A wall construction assembly, comprising a plurality of spaced structural components, each structural component comprising an elongate web, first and second mounting flanges at each end of the web, and one or more pairs of opposed first and second supporting fins extending from the web in a substantially lateral direction thereto, the

assembly further comprising at least one wall panel connected to one of the first and second flanges and insulation supported between adjacent structural ribs.

13. A wall construction assembly as claimed in Claim 12 wherein the assembly further comprises an insulation layer attached to the other of the first and second flanges.

14. A wall construction assembly as claimed in Claim 13 further comprising a cladding rail between the insulation layer and the rib.

15. A wall construction assembly as claimed in Claim 14 has a cladding panel connected to spacing block between structural rib and cladding panel.

16. A wall construction assembly as claimed in any of Claims 12 to 15 further comprising insulation disposed between the first and second fins of the structural component, and the first and/or second wall panel, the insulation extending between adjacent structural components.

17. A wall construction assembly as claimed in Claim 16 wherein the first and second flange portions of the structural component have slots in opposite sides thereof for receiving cladding accessories.

18. A wall construction assembly as claimed in Claim 17 wherein the free end of the first and/or second fins is adapted for complementary engagement with cladding accessories, for example, insulation restraining straps, bars or panels.

19. A wall construction assembly as claimed in Claim 18 wherein the free end of the first and/or second fins has a slot for receiving the cladding accessory.

20. A wall construction assembly comprising a structural rib as claimed in any of Claims 1 to 11.

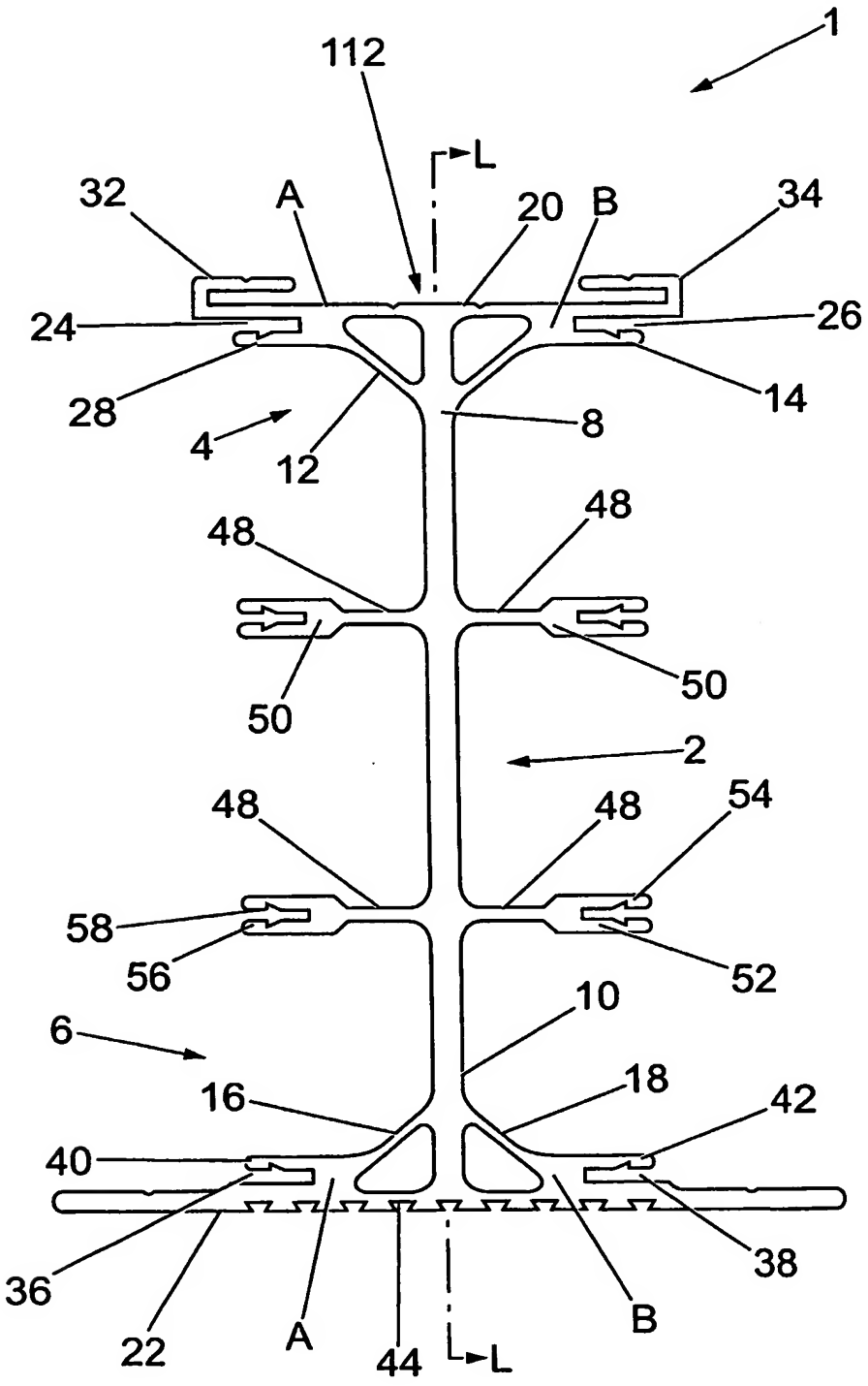
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Fig. 1

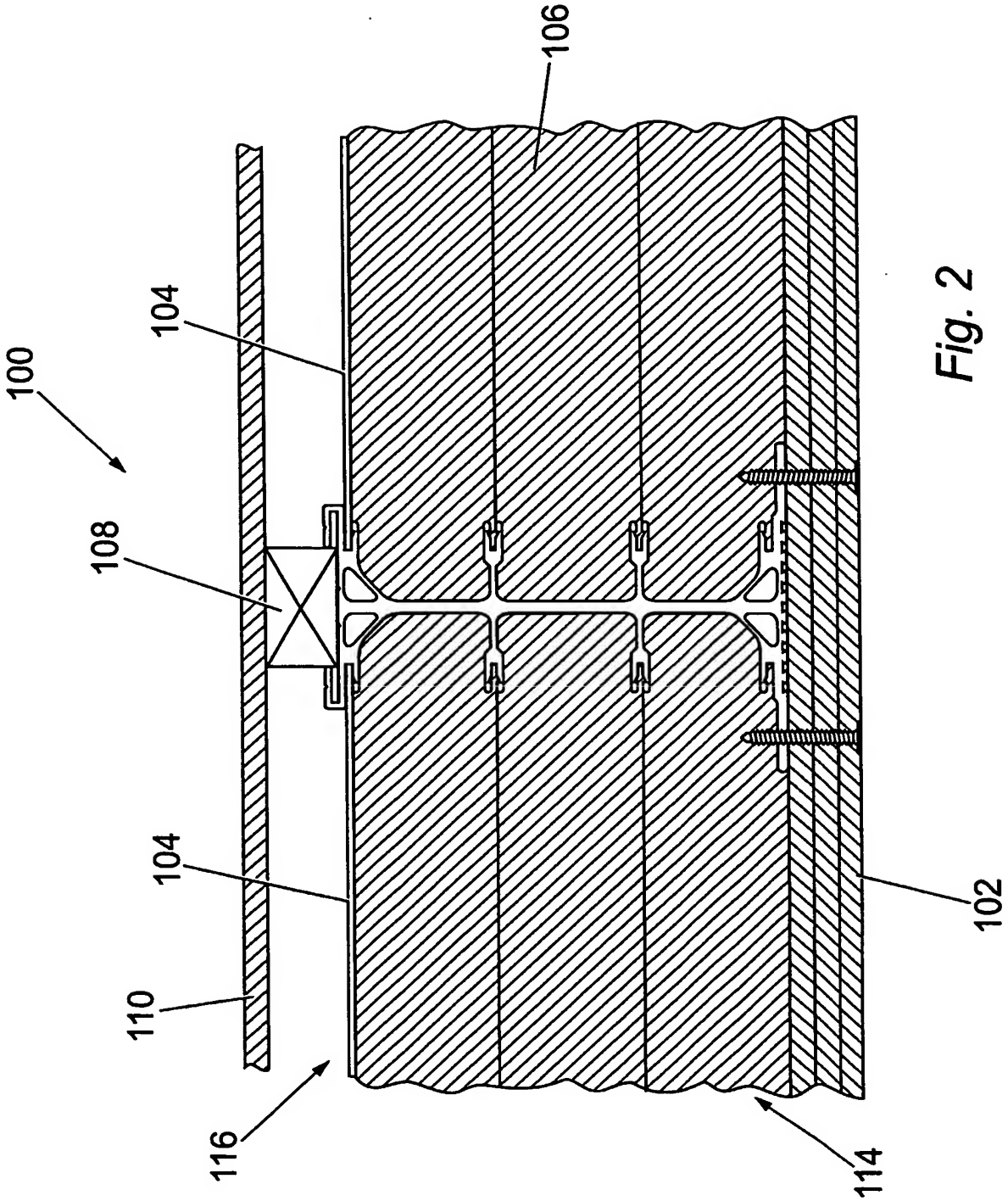

Fig. 2

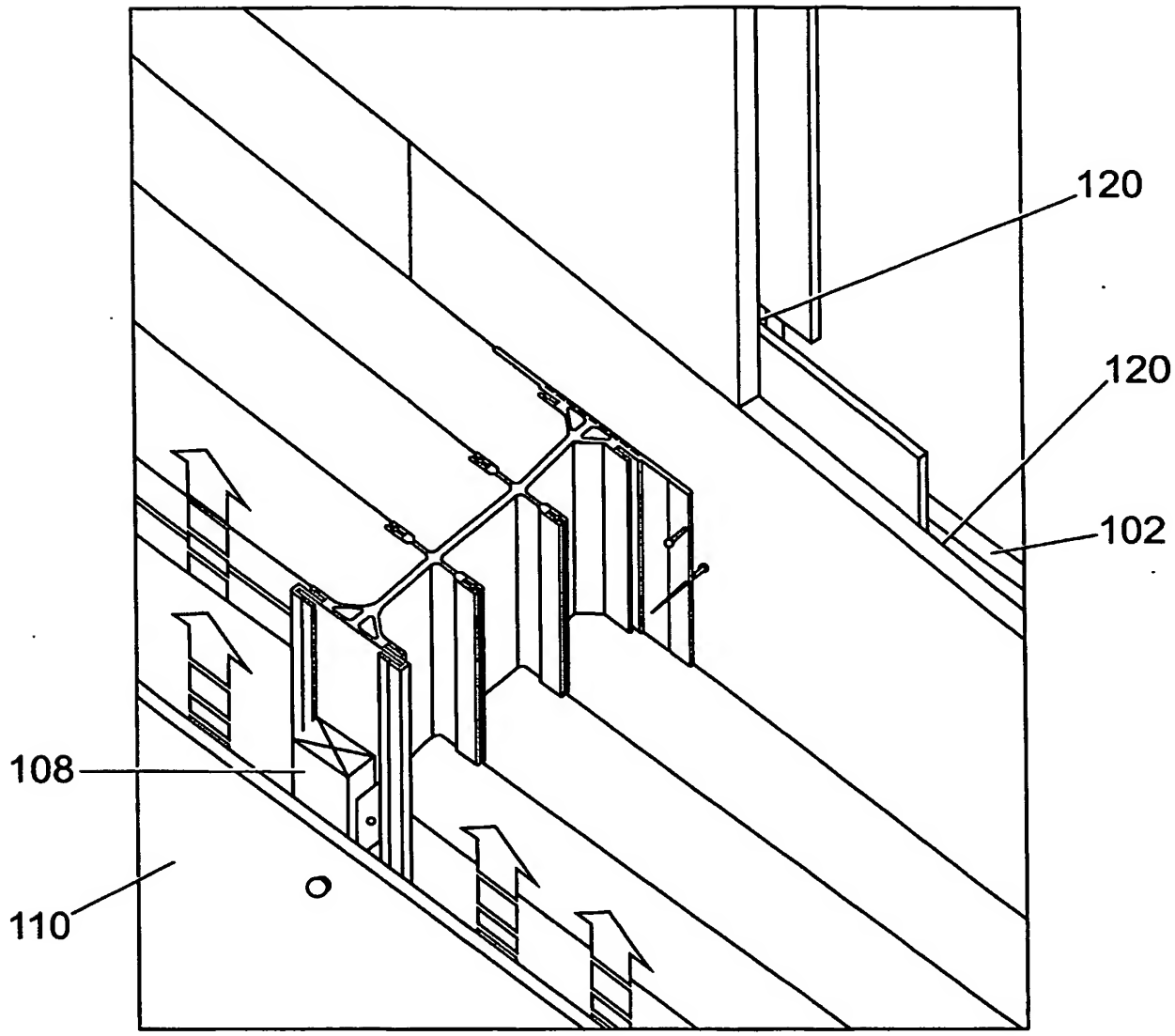

Fig. 3

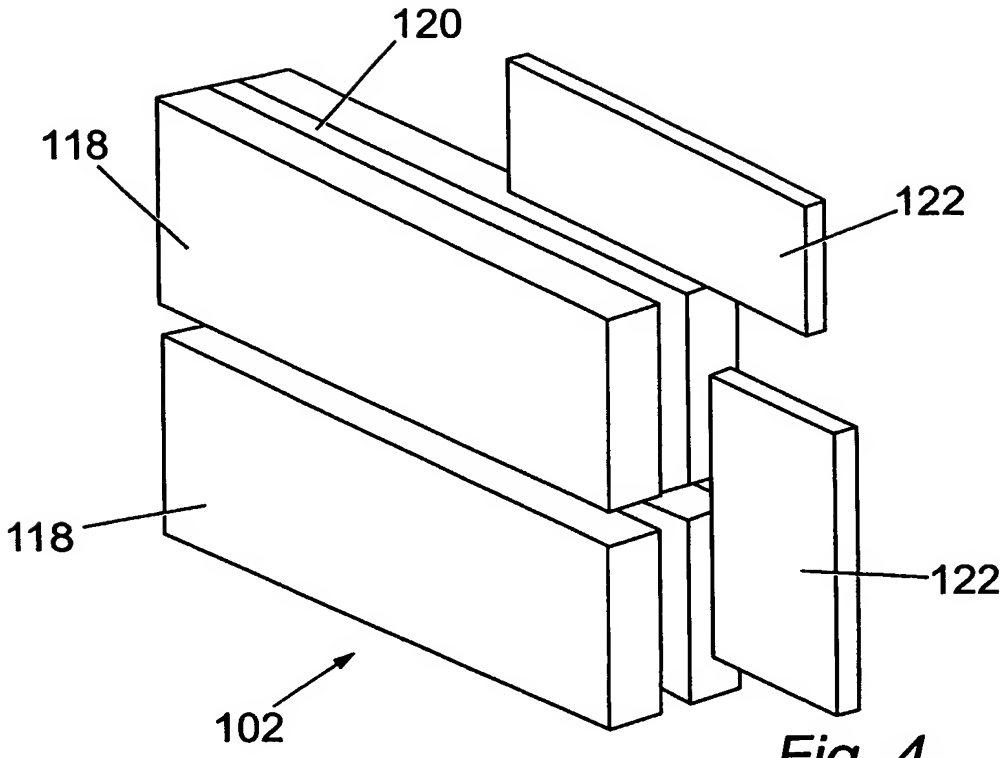

Fig. 4

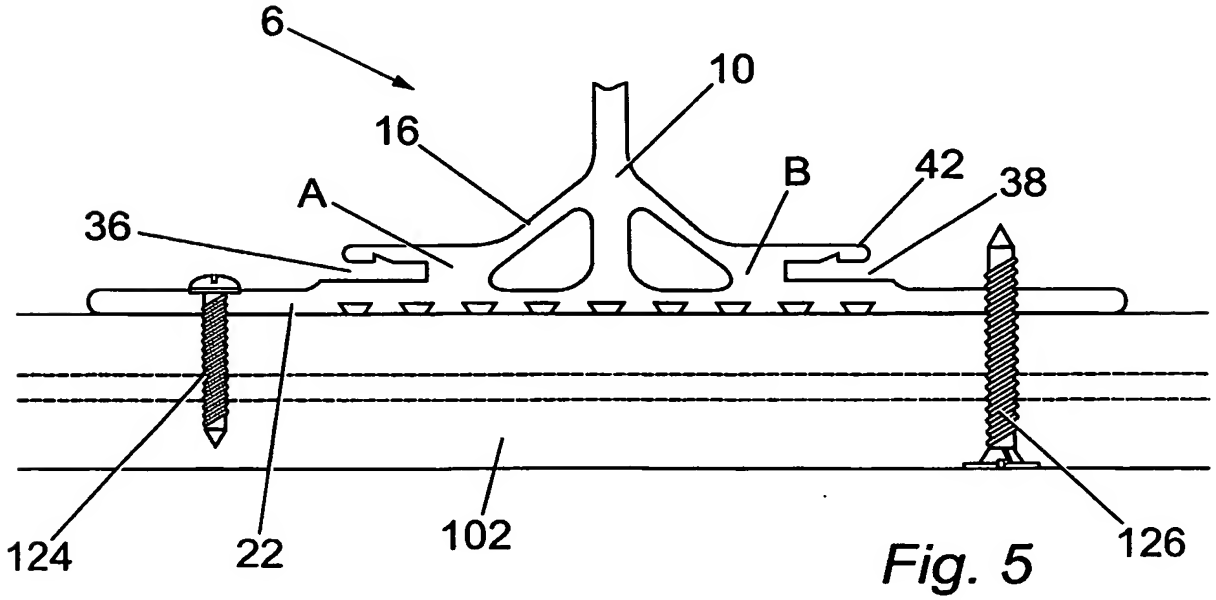

Fig. 5

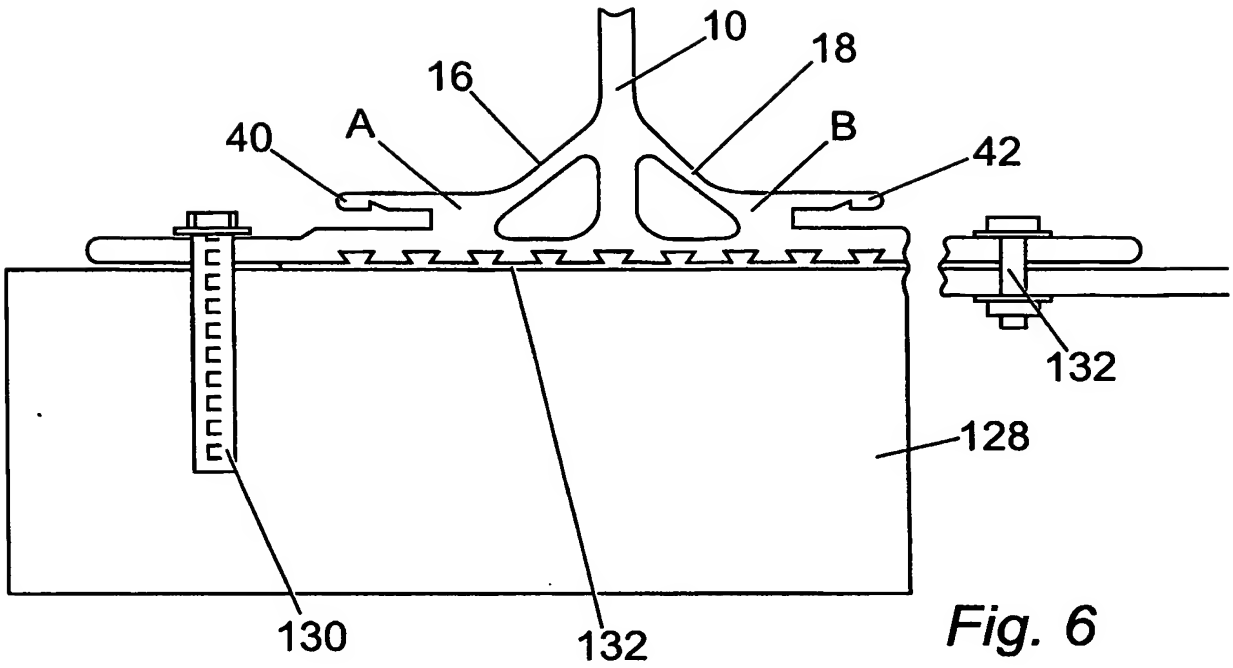

Fig. 6

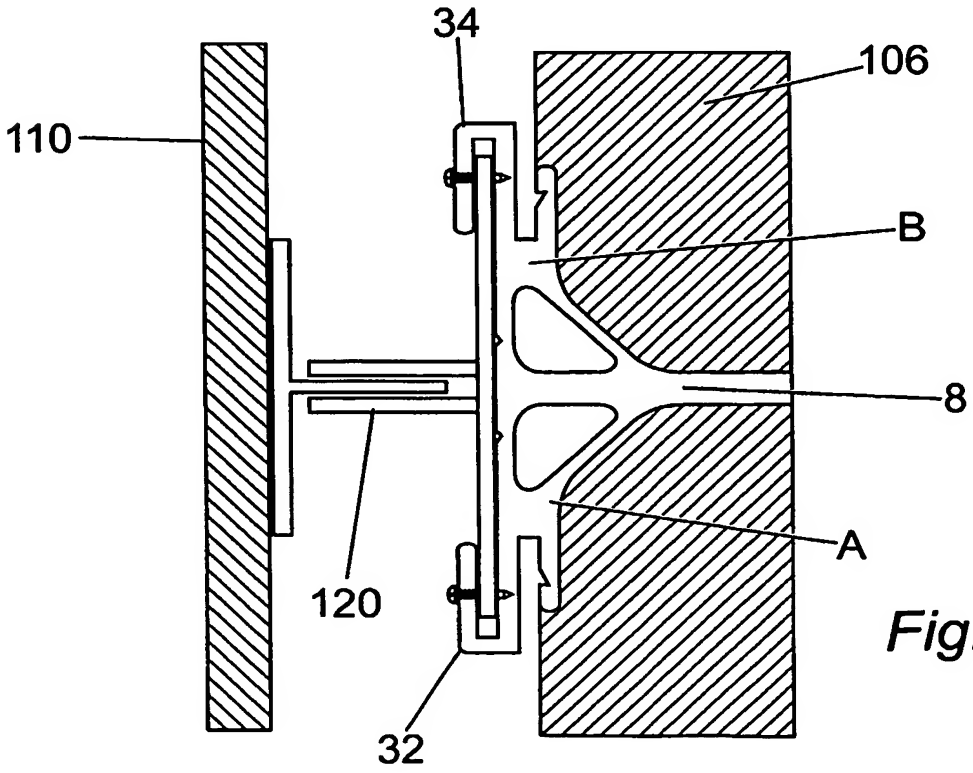

Fig. 7

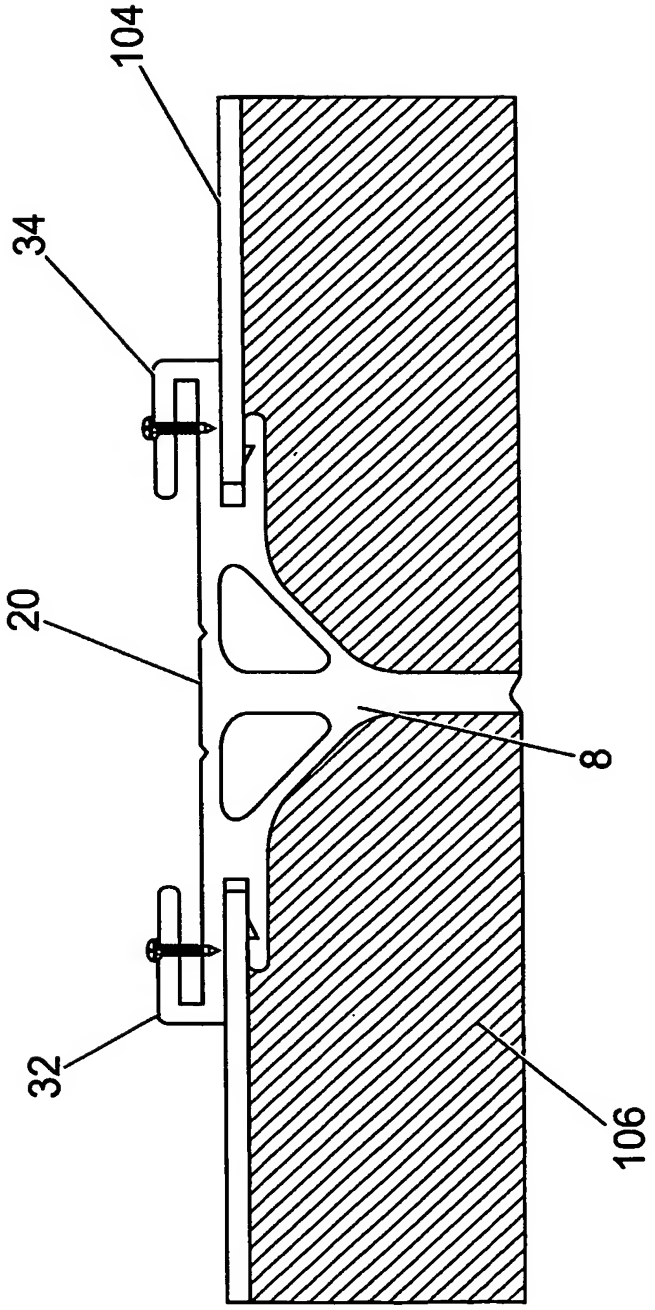

Fig. 8

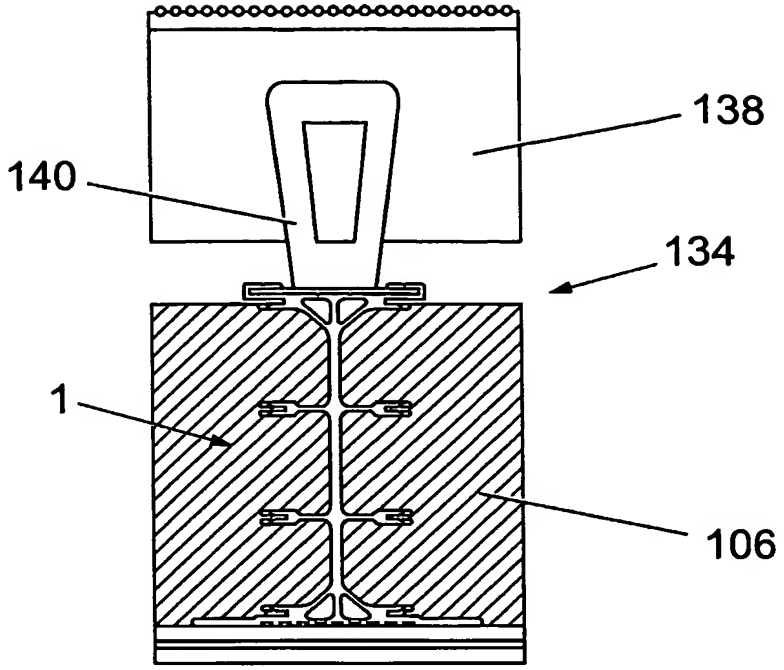

Fig. 9

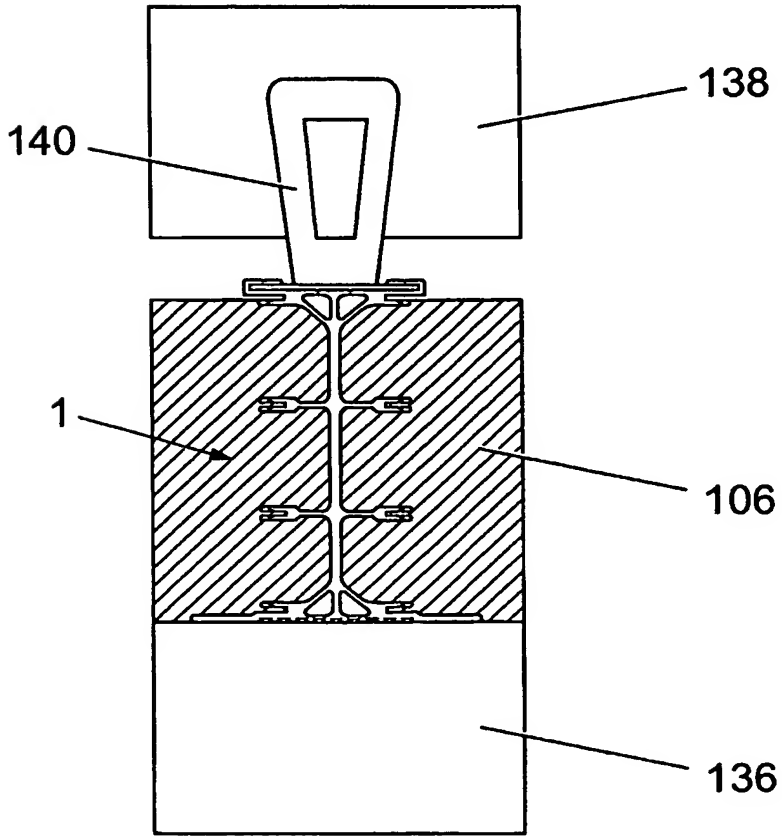

Fig. 10

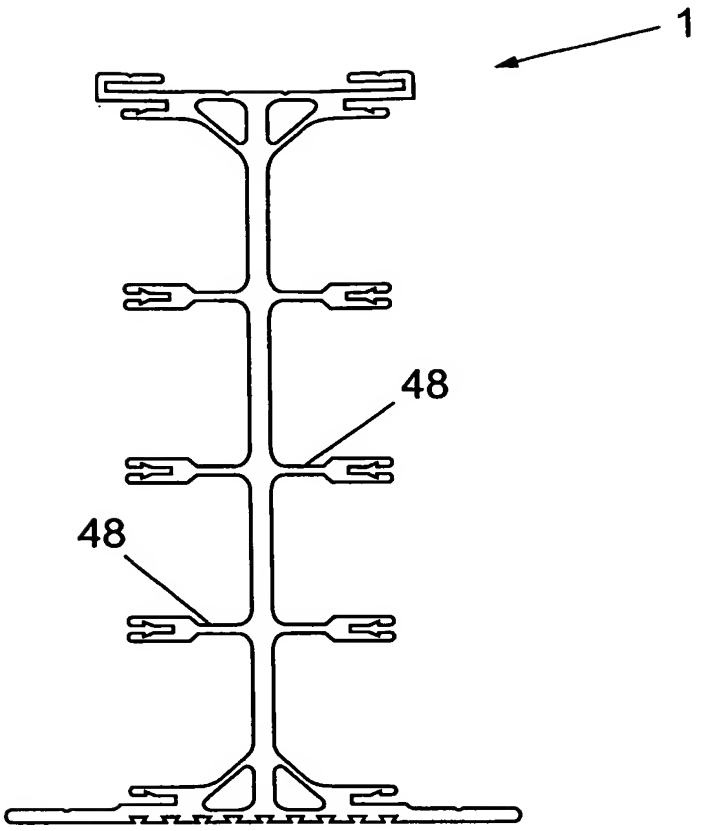

Fig. 11

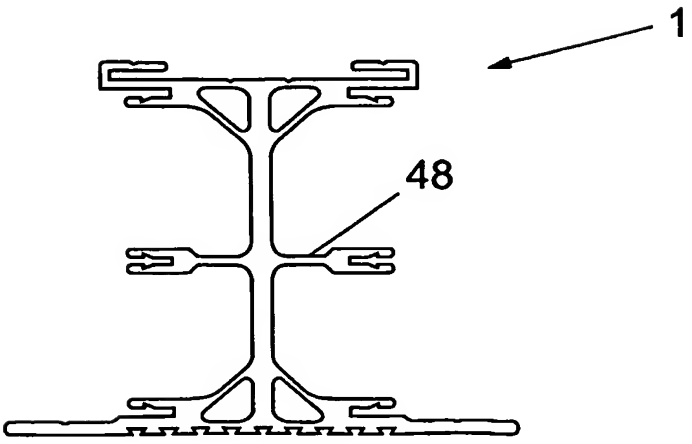

Fig. 12

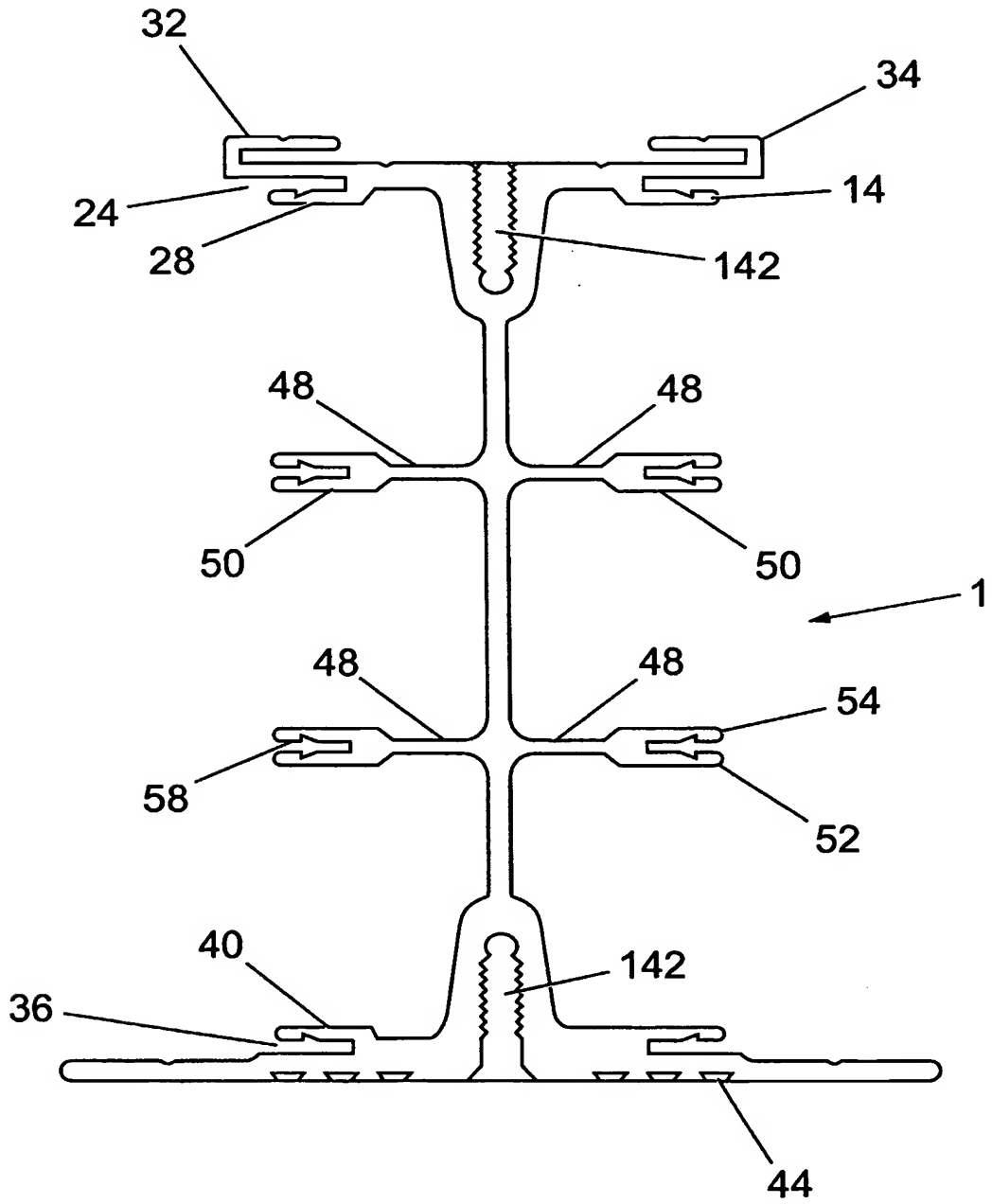

Fig. 13

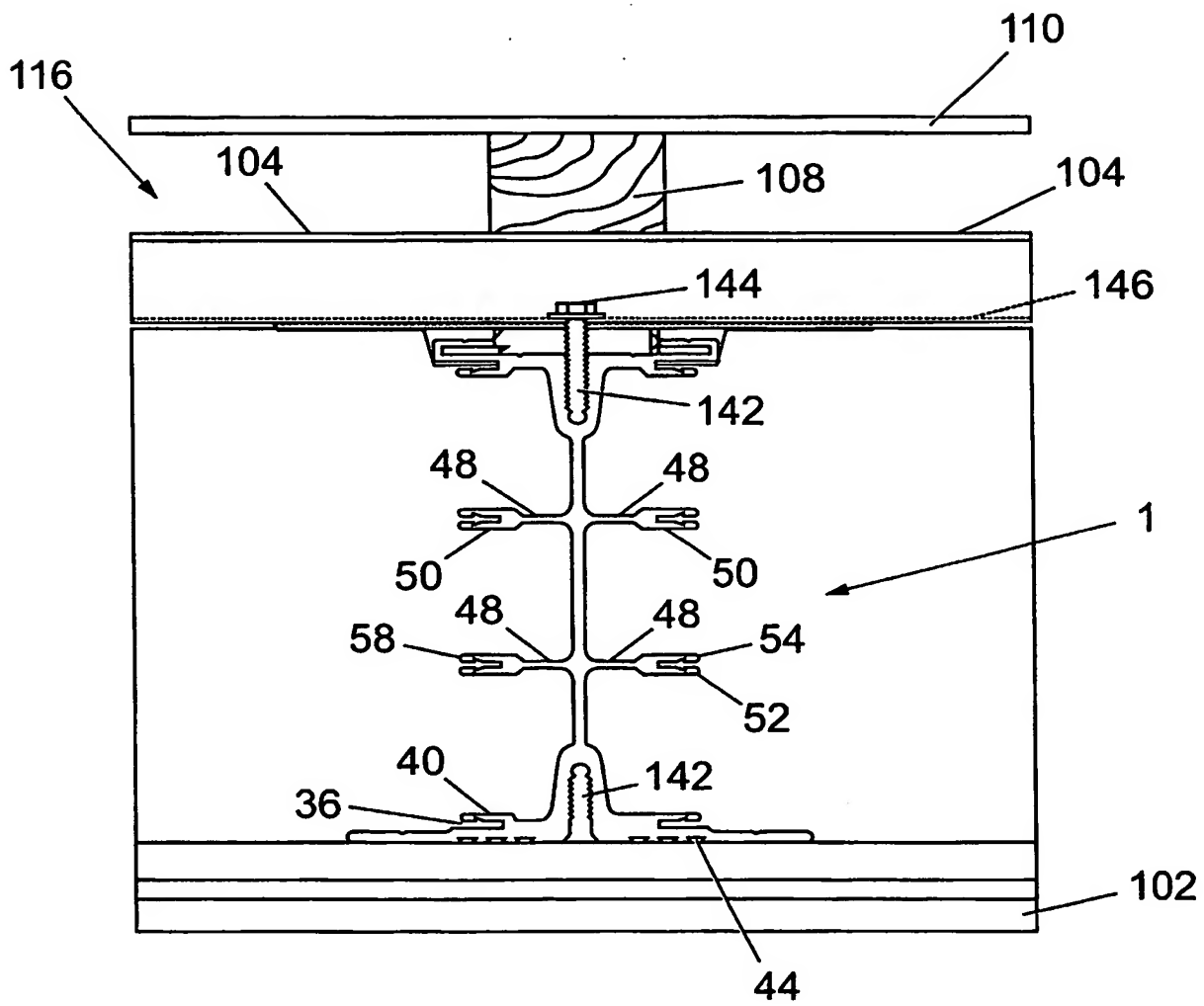
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Fig. 14

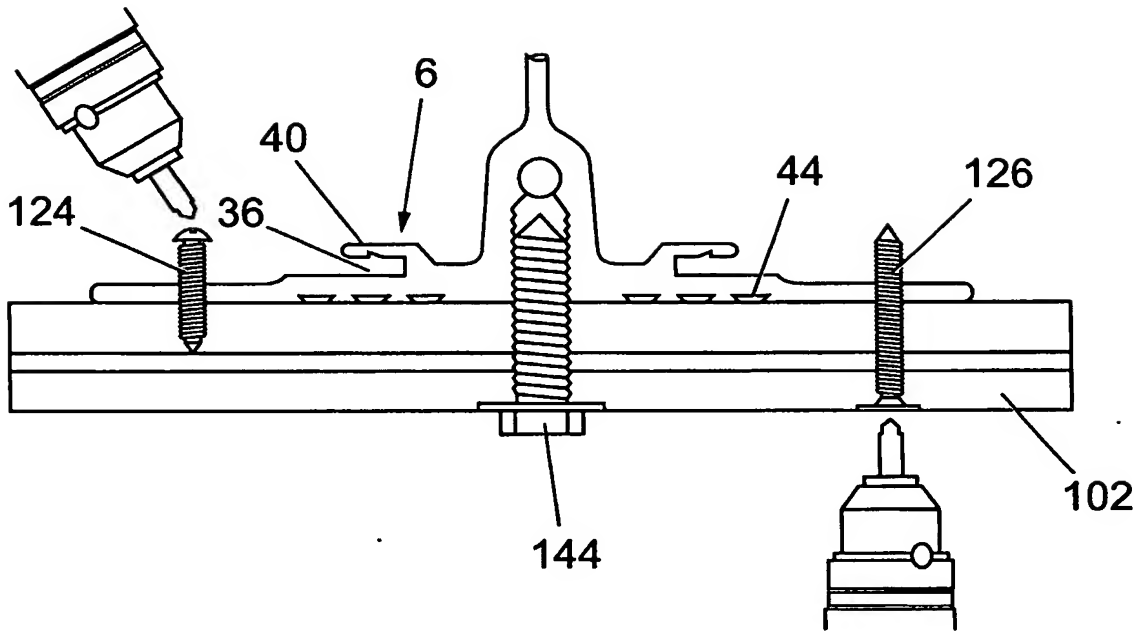

Fig. 15

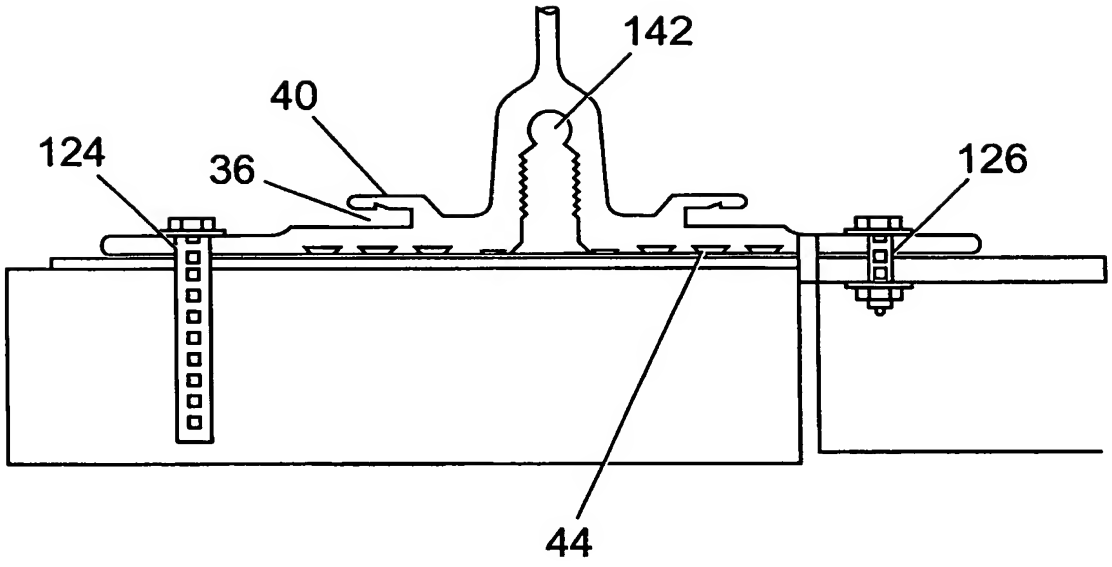

Fig.16

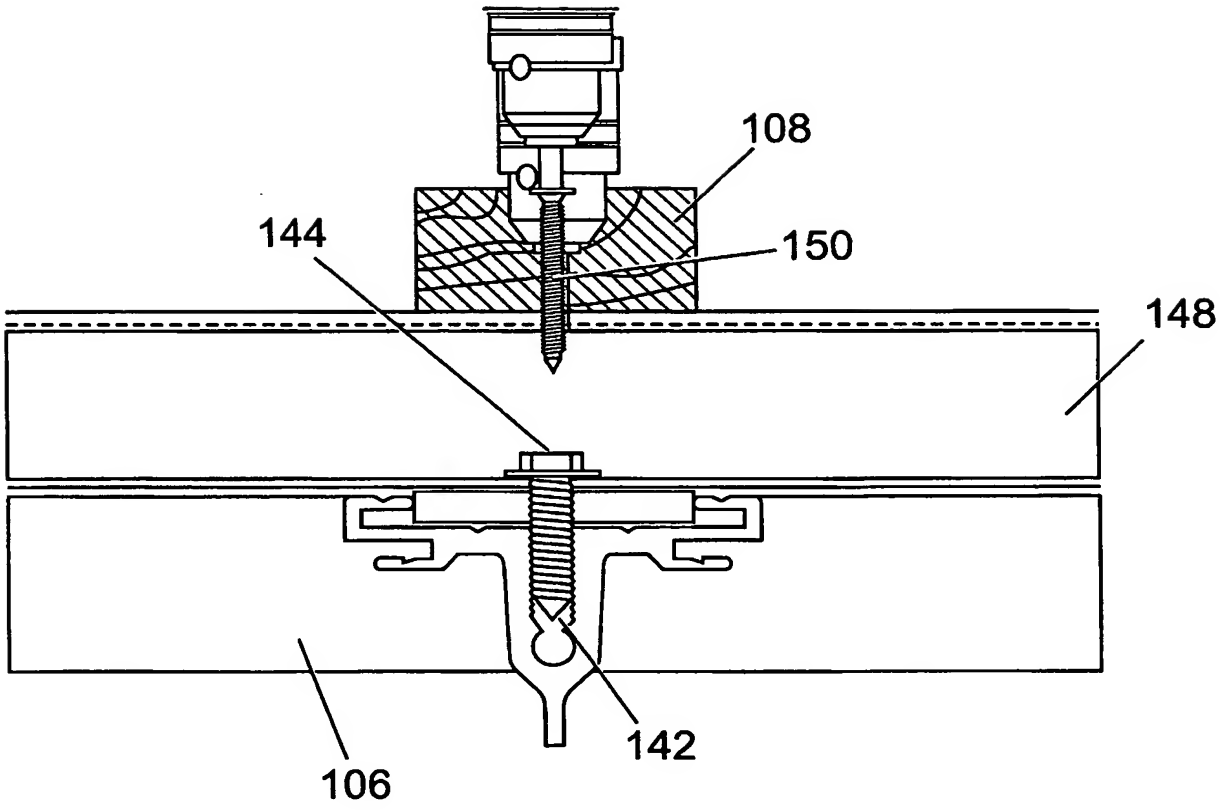

Fig. 17

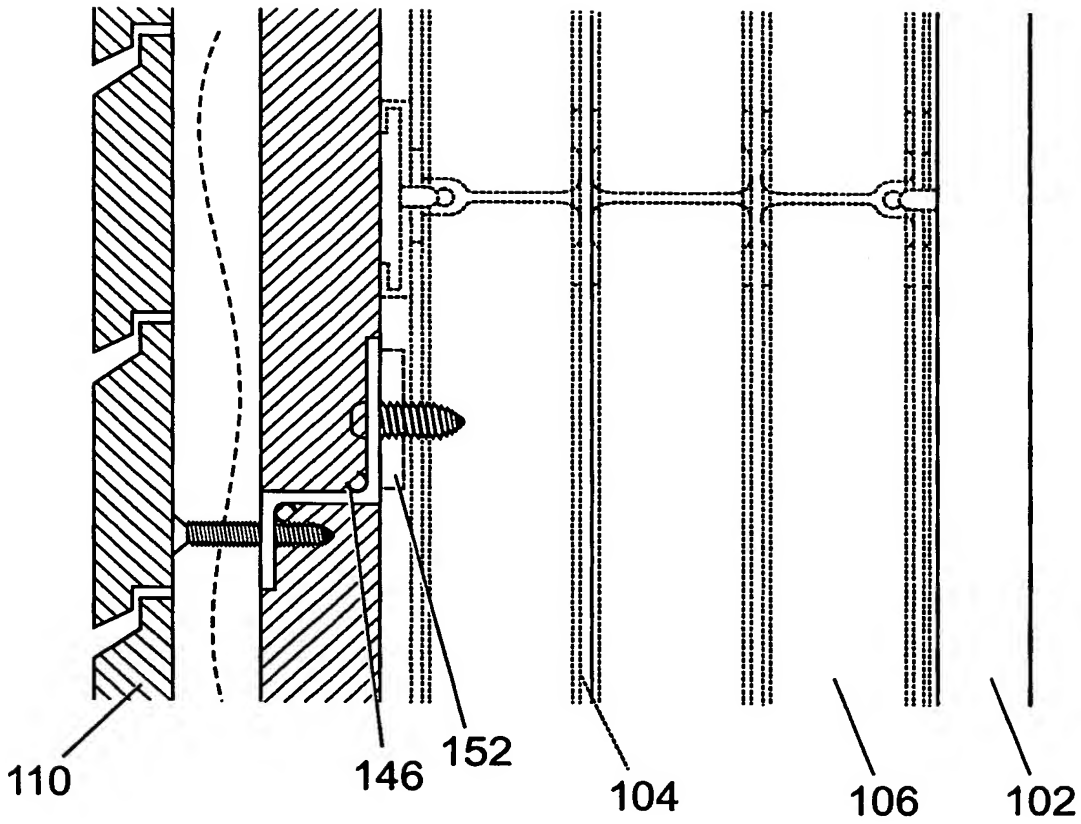

Fig. 18

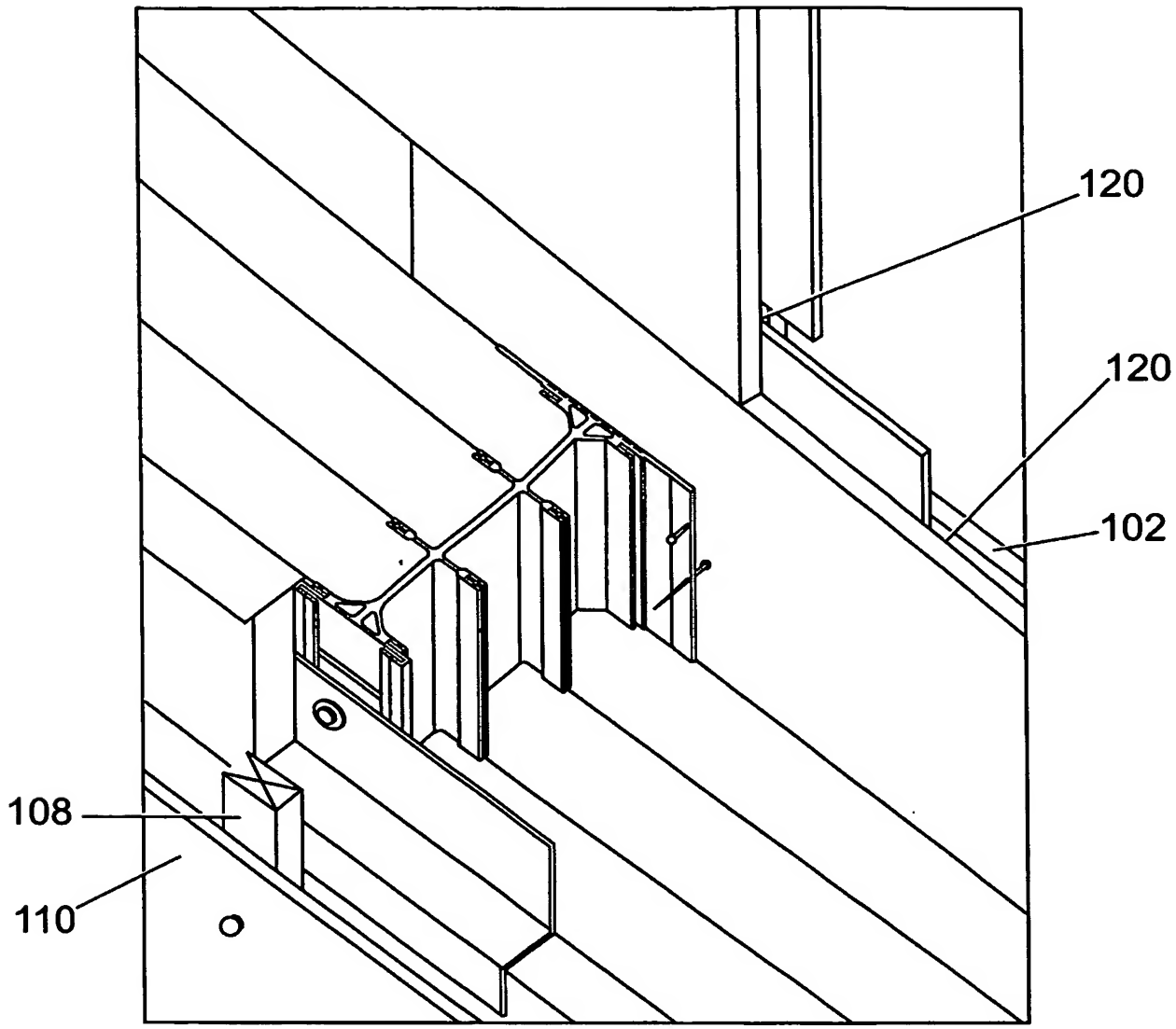

Fig. 19

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/04606

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04B2/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 510 720 A (J.STEWART) 12 December 1893 (1893-12-12) the whole document	1-6,12, 13,20
Y		7,8
X	FR 1 548 556 A (FERMETURES F.M.B VENDOME) 6 December 1968 (1968-12-06) figure 1	1,9,10
X	US 4 435 936 A (RUTKOWSKI EDWARD J) 13 March 1984 (1984-03-13) claim 1; figures 1-3	1,11-13, 16-18
X	US 4 443 991 A (MIEYAL DAVID F) 24 April 1984 (1984-04-24) figures 2,5	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 February 2004	13/02/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Rosborough, J

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/04606

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 2 213 355 A (WOODWORTH ROY D) 3 September 1940 (1940-09-03) figure 1	7,8
A	US 4 655 014 A (KRECKE EDMOND D) 7 April 1987 (1987-04-07) abstract; figures 1,2	10
A	US 5 996 299 A (HSUEH YI-CHENG) 7 December 1999 (1999-12-07) figures 1,4	17

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